What Students Want: Using A Need-based Innovation Approach for Digitizing Higher Education

Sebastian Brenk
RWTH Aachen University, Institute for Technology and Innovation Management (TIM)
brenk@time.rwth-aachen.de

Abstract

Incumbent organizations like universities lack capabilities of how to make sense of student learning needs to guide digitization activities that develop and implement new e-learning technologies. This paper contributes a methodological approach based on the jobs-to-be-done theory that assists universities in digitizing their learning and teaching processes. This study applies the Outcome Driven Innovation (ODI) approach to assess students' learning needs in the learning process of higher education. The results from the ODI methods are valuable to create need-based data intelligence that supports sensemaking about digitization strategies at universities and fosters the development of e-learning platforms and analytics.

1. Introduction

In today's age of digitization and especially since the COVID-19 pandemic, higher education passes through an emerging shift from traditional and analog learning approaches towards new, electronic, or digital learning patterns based on Information Communication Technologies (ICT) [1–3]. Digital learning platforms with integrated ICT are considered as the new backbone for future university education. For lecturers like professors or teaching staff, and students, these ICT-based learning technologies and platforms enhance access to learning resources, information, and new educational tools like MOOCs or concepts like Flipped Classroom, which supports face-to-face, remote, and distance learning in- and outside the university boundaries [4]. However, the digitization of higher education challenges the traditional strategic orientation and structure of higher education institutes [5]. Traditional universities have to reconfigure and alter their current routines and organizational structures to explore and exploit possible opportunities for e-learning technologies. The main challenge is that organizational administrators struggle to assess the implications of e-learning implementation for their universities [4, 6].

Universities lack capabilities to effectively make sense of digitization activities and differentiate these from activities that do not significantly improve the quality of teaching and learning [3, 7]. Emerging learning technologies, patterns, and changing learning needs of students in terms of flexibility in knowledge, social skills, and adaptability pose market opportunities but also uncertainty and risks for higher education institutions [3, 5]. Organizational sensemaking of developing and exploiting new e-learning technologies is an essential prerequisite of transformative strategy processes for universities. Sensemaking builds an understanding of an artifact and its implications while dealing with limited amounts of available information [7–9]. Hence, universities have to make sense of and address new, emerging needs and problems that students as central stakeholders encounter during the digitization of their learning process [4].

In innovation management literature, a key factor determining the success of new product and service development is identifying and addressing unmet needs and integrating this user need information in the strategy and innovation process [10–13]. An empirical understanding of collected user need information (e.g., user requirements, problems, expectations, opportunities, and goals) are essential because the successful development of (digital) products, services, and infrastructure and its adoption will rely on created user knowledge [10].

Hence, universities should implement and use e-learning technology and tools to serve identified students' learning needs and strengthen the learning process. A focus on student needs provides a stimulus for the digital transformation of education and guides the identification and implementation of useful e-learning tools and platforms in the learning process. However, universities lack effective methodologies to identify student needs and opportunities for effectively innovating and implementing e-learning technologies for digitizing higher education [2]. This paper aims to contribute a methodological approach that supports the sensemaking of incumbent organizations like universities to digitize their learning and teaching process by addressing student needs more effectively [8]. To do so, this research study investigates the following research question: *How can an established university make*

URI: https://hdl.handle.net/10125/79342
978-0-9981331-5-7

sense of student learning needs as a solid groundwork for the digitization of higher education?

The following paper contributes a mixed-method approach [14] based on the jobs-to-be-done theory, which assesses student needs within the learning process of higher education to support organizational sensemaking in the digitization process of universities. This study selects and applies Outcome Driven Innovation (ODI) methodology as a systemized innovation approach that enables organizations to gain a deep and validated understanding of student needs and problems. The ODI methodology enables organizations to build an accurate understanding of needs and its underlying outcome metrics that students use to evaluate the outcome of their learning process [15, 16]. The ODI study results reduce innovation uncertainty about new learning technologies and their fields of opportunity by understanding jobs-to-be-done as clusters of student needs. Universities can link the generated ODI results to other information sources and analytics to create need-based data intelligence supporting organizational sensemaking for digitizing the learning process [17]. The application of the ODI approach in this study shows that a open e-learning platform with a blended learning concept has the job-to-be-done to simplify the organization and communication while enhancing the access to various learning resources and data to improve the learning process and outcomes of students [16].

2. Outcome driven innovation for digitizing higher education

Established universities still struggle to implement new technologies and concepts like blended learning into their established teaching portfolios and organizational structures [4, 6]. They are willing to exploit emerging technologies but are cautious of getting a victim of unsubstantiated hypes and wasting resources on wrong e-learning technologies. In this sense, investment in new e-learning solutions must be well planned because universities as public organizations are restricted in their resource base to experiment [3]. Therefore, university decision-makers are frequently challenged to make sense if certain e-learning technologies effectively address student needs [7].

Within the process of digitization, decision-makers are confronted with limited information and uncertainty about the utilization and future benefits of new nascent technologies [7, 8]. New e-learning technologies like MOOCs, Virtual and Augmented Reality, or concepts like Flipped Classrooms, Gamification, etc., are ambiguous in their effectiveness of improving higher education [1]. Since these e-learning technologies and concepts often allow a broad range of educational possibilities, the challenge is to make sense of specific applications that enhance the learning process and address the learning needs of students [7]. It is evident that specific application areas and benefits are not well articulated or understood, which necessitates an effective method of sensemaking for implementing and adopting e-learning innovations. Profound sensemaking can reduce information asymmetries by initially understand student needs linked to new technologies and their fields of opportunity [17]. Griffin & Hauser (1993, p. 5) define a need as the users' own description "of the benefit that he, she, or they want fulfilled by the product or service" [18]. However, collecting need information from a large user group (~45k people) is a tedious task, especially in an organized and structured manner. Analyzing, structuring, and extracting information about user needs to support the sensemaking for implementation and introduction of new e-learning solutions is difficult and prone to bias [19].

Universities can gain a deeper understanding of student needs using market research techniques [18, 19]. This knowledge can be used to nurture the formulation of a digitization strategy. There are many methods and approaches to identify needs by listening to the voice of the customer, such as focus groups, personal interviews, ethnography, lead user analysis, and storytelling or solution-focused thinking approaches like design thinking, etc. [19]. Although strategic marketing offers an extensive set of tools to examine customer needs, managers or administrators often lack the ability to transfer the user and customer need information into metrics that can be employed for strategic decision-making [16]. Despite big data and enormous user information and marketing methods in the digital age, user needs are often misunderstood. Users and customers have difficulties expressing and articulating their own needs, which often leads to misinterpretations or wrong conclusions, reinforcing the failure of innovation activities. Moreover, users and customers can often not express what they need due to functional fixedness to an existing product or service (e.g., if a product is presented during the research activity) [16, 19, 20].

Christensen et al. [15] argue that most data gathering approaches primarily provide correlations, but these are not suitable in understanding the why of user or customer behavior. They argue that organizations should identify what job users or customers are trying to get done when they acquire and use a specific product or service solution [15]. Users and customers employ products or services to receive a certain outcome or goal. To evaluate a product or service, a set of metrics is applied to measure how effectively the solution can contribute to the degree of their job achievement [21]. According to the job-to-be-done theory of Christensen et al. [13, 15], a job is defined as a problem a customer or user encounters in a given situation or a need that has to be satisfied. A job is detached from any solutions, meaning that a customer can use different

solutions to get the same job done. However, one product or service may get the same job done better than others, which influences the evaluation and affects the future purchase and use decisions [22]. Organizations ought to gain a deeper understanding of the core jobs their products and services have and how users or customers measure successful or failed job execution [13]. Therefore, universities must understand their students' jobs-to-be-done and their desired outcomes as e-learning users or customers while aligning innovation activities accordingly. The jobs and outcomes (i.e., evaluation criteria) of e-learning technologies in the student learning process can be identified using the Outcome-Driven Innovation (ODI) approach as a suitable methodology [22].

The ODI method is a holistic innovation approach that is based on the job-to-be-done theory [13, 15]. The ODI approach focuses on uncovering customers' metrics to evaluate solutions and converting them into measurable items [16]. So far, the method is mainly used for the development of new products and services. However, as the method enables transforming fuzzy needs into measurable outcomes, the ODI approach may enrich the sensemaking of digitizing higher education [23]. So far, research has missed examining the needs/problems of students regarding the digitization of learning [4, 5]. Following the ODI approach, this study applies a qualitative study to obtain student needs and metrics used to evaluate the learning and teaching process with its underlying needs. Afterward, the identified needs are converted into quantifiable outcomes statements for validation in a quantitative study to increase the objectivity of the results [16]. The evaluated outcomes statements are a solid groundwork to validate further student needs for e-learning solutions, which increase the knowledge base for strategy formulation, service, and product development. The ODI as a mixed-method approach overcomes the structural flaws of other market-research methods by linking qualitative and quantitative customer-orientated research techniques (see Section 3) with the job-to-be-done perspective that supports sensemaking and decision-making of innovation projects [16, 22].

3. Research method

3.1. Research setting

The following research applies a multi-year longitudinal in-depth case study of a leading German university, which has a pioneering role in digitizing higher education in Germany. Longitudinal case studies are suitable for the development and implementation of new methods and practices [24]. The RWTH Aachen University (RWTH Aachen) was chosen as a study object because it is one of the leading German technical research universities with over 47k enrolled students. RWTH Aachen aims to develop a holistic digitization strategy on which different faculties can build on for their e-learning development and implementation to improve the learning outcome of their students. An independent research team of RWTH Aachen applied the ODI approach to explore the needs and problems students encounter in the learning process.

3.2. Data collection and analysis using ODI

The first step of a qualitative interview study. In the qualitative part of the ODI study, 45 students were interviewed, and these interviews were recorded and transcribed. A semi-structured interview guideline leads the qualitative research part with a pre-defined question sheet [14]. We have applied a purposive sampling strategy to select interview partners to ensure a great variety of needs and problems regarding students' learning process. A purposive sampling strategy enables the researcher to choose participants based on their environment and personality traits [14, 25]. Interviewees involved many different students from all faculties, such as bachelor students, master students, working students, students with learning difficulties, commuting students, and students with children. To cover different fields of study, participants had different study backgrounds, including social sciences, engineering, natural sciences, and medicine. Based on these assumptions, the sample consisted of 17 female and 28 male students enrolled at the RWTH Aachen with an age of 18 to 30 years. 18 students were enrolled in a bachelor's degree program, 21 participants of a master's degree program, and six participants would end their academic education with a state examination.

In the qualitative interviews, special emphasis was given to extracting the need statements within the learning process. We have investigated three categories of information to receive sufficient student input. At first, the jobs within the learning process need to be identified. Secondly, the outcomes that students are trying to accomplish must be clarified. Finally, the potential constraints and problems from using any (new) service or product are at focus [20]. However, customers or users experience great difficulties expressing their needs, making it difficult to extract that information [19]. One concept to facilitate the exploration of need information is job mapping and clustering according to users' and customers' needs and problems. This method decomposes a job as a specific task and divides it into eight discrete and fundamental process steps (define, locate, prepare, confirm, execute, monitor, modify and conclude the learning) with underlying outcomes. Students experience different problems and needs in each step, focusing on dedicated objectives explored throughout the interviews [20].

Once the interviews have derived the job and the underlying needs, the obtained quantitative data must be analyzed and prepared for the quantitative study. In general, one interview can generate between 50-150 need statements, requiring a minimum sample of 10 to 15 interviews to extract and validate the majority of needs in a certain investigated field [18]. A team of independent researchers categorized and aggregated the need statements to reduce the complexity and eliminate redundancies in the qualitative data [25]. In the next step, we screened the reduced set of relevant statements, and we selected needs that necessitate a further quantitative evaluation. The evaluation and selection of the need statements are based on their frequency, distinctiveness, or latent characteristic of student learning in the interviews [16]. An evaluation workshop with involved students and lecturers evaluated and selected a set of relevant student need statements for the following quantitative study.

According to the approach of Ulwick [16], the need statements (e.g., flexibly to rework a lecture for my own) are converted to assessable outcome statements. Every outcome statement must be measurable, controllable, and predictable and therefore follows the same structure [21]. An outcome statement always starts with the direction of improvement (e.g., minimize, maximize, reduce or increase), followed by a performance metric (e.g., likelihood, amount, or number), an object of control (i.e., the desired outcome), and a contextual clarifier [16, 22]. Based on the data of the structured in-depth interviews and workshops, we selected a set of 36 outcome statements for further quantitative evaluation (see Appendix 1).

The second step of quantitative validation. Next is to prioritize the extracted outcome statements to unveil the most promising ones among all identified needs. Ulwick [16] defines an underserved need (desired outcome) as an opportunity. More specifically, the opportunity results from an outcome statement, which is important to the users or customers, but where they are not satisfied with the current solution [21]. We evaluated each of the 36 outcome statements in an online survey based on two factors – the degree of importance and satisfaction. Both dimensions are surveyed using a 5-point Likert scale, where 5 means extremely important or satisfied and 1 means not important or satisfied at all. Despite the relevant outcome statements, the survey included demographic data and questions concerning learning and teaching behaviors. The online survey was distributed using official channels of the RWTH Aachen. After data cleaning, we used 3489 observations as an input for quantitive analysis. According to the university key data, this reflects approximately 7.4% of the student population. The sample consisted of 64 percent of bachelor students, 30 percent of master students, and 6 percent were pursuing a state examination degree. Furthermore, 63 percent of the respondents were male and 37 percent female. Regarding the fields of study, 58 percent were engineering students, 23 percent came from natural sciences, 13 percent were social sciences students, and 6 percent were medical students. Overall, the sample is representative of the targeted population. Additionally, the rather large sample size allows for detailed analyses by segmenting the data at the faculty level [16].

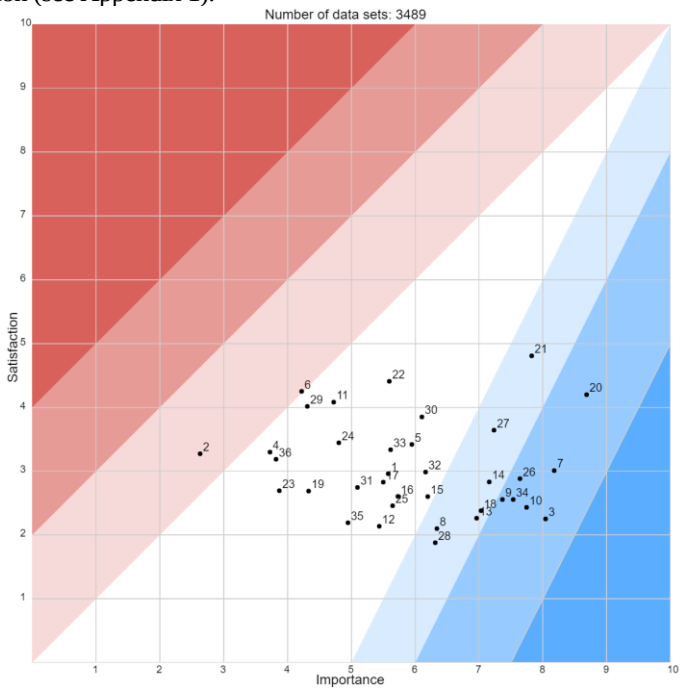

Figure 1. Opportunity map with student needs according to Ulwick (2005) with outcome statement evaluation areas: over-served in red, appropriately served in white, and under-served in blue

The ODI method provides two instruments to analyze the obtained data: opportunity map and opportunity score. For both tools, metrics for importance and satisfaction are needed. The so-called importance and satisfaction scores used for this calculation are the relative share of observations that have evaluated an outcome statement with 4 or 5 on a 5-point Likert scale. For example, if 80% of the respondents used a 4 or 5 to evaluate the importance, and 22% of the respondents rated satisfaction with 4 or 5 of an outcome statement. After norming the scores from 1 to 10, the respective score for importance is 8.0 and for satisfaction 2.2, which are the coordinates for the outcome statement having the ID 3 in Figure 1 [16].

Based on these scores, we generated the so-called opportunity map (Figure 1), which provides a graphical overview of the data and the respective innovation potential of the outcome statements. The outcome statements are depicted in a two-dimensional space, where the x-axis describes the importance of the respective outcome statement and the y-axis refers to the level of satisfaction [16]. The importance and satisfaction axes span a need landscape that categorizes the outcome statements into three categories: over-served (red), appropriately served (white), and under-served needs (blue). The blue area is defined as the area of innovation opportunity. Whereas the opportunity map is a graphical evaluation tool, we employ the opportunity score as an overall index to derive a hierarchy of needs [16]. The opportunity score helps quantify each outcome statement's innovation potential, which enables a comparison of these. The score results from a mathematic equation: *Opportunity Score = Importance + max [Importance - Satisfaction]*.

For outcome statement 3, 80% of the respondents rated importance and 22% of the respondents rated satisfaction with a scale of 4 or 5. This results in an opportunity score of (8.0+max(8.0-2.2) = 13.8 [16]. The opportunity scores can lie within a continuum of 0 and 20. A score of more than 10 defines an opportunity for innovation. Opportunities above 12 are considered to have a high innovation potential. Scores above 15 have an extraordinary innovation potential. All scores below 10 can be neglected at this point. Those needs are either appropriately served or unimportant and therefore do not require any resources or even offer possibilities to reduce costs if they do lie in the red overserved area [16]. After measuring the score for an opportunity in a quantitative survey, organizations can now identify unmet needs directly and prioritize these needs by creating aggregated jobs-to-be-done by ranking and clustering common outcome statements [21].

4. Results of outcome driven innovation

This section presents our results from the ODI studies to enhance our understanding of the learning processes. The results from 45 in-depth interviews show that students are looking for ways to enhance their learning process with new digital learning tools, and they appreciate the increased flexibility through ICT. However, students also value traditional teaching concepts and face-to-face learning with a lecturer, which is more motivating and has a higher perceived degree of credibility. Therefore, an e-learning solution may best be suited to facilitate the organization and execution of learning activities but cannot fully substitute analog learning interactions with lecturers at all. From the quantitative survey with 36 evaluated outcome statements, we identified 14 under-served needs in students' learning process, which pose high opportunities for innovation (see Figure 1 and Appendix 1). We used the opportunity equation to rank each outcome statement according to the opportunity score and only consider outcome statements with an opportunity score of 10 or more (see Table 1).

Table 1. Need-based opportunity clusters of outcome statements (OS = Opportunity Score)

Opportunity Cluster	ID	Outcome Statement	OS
Availability of learning materials and information	3	Maximize the likelihood that literature is free, flexible, and online available.	13.8
	20	Minimize the amount of missing learning material.	13.2
	13	Reduce the effort to obtain additional information from a lecture (e.g., additional examples, further explanations, application tasks, etc.).	11.7
	27	Reduce the effort to find certain information and content using (e.g., on e-learning platforms, etc.).	10.8
Pragmatism of learning	7	Increase the flexibility to rework lectures individually (e.g., from home, mobile).	13.3
	10	Increase the graphicness and clearness of course content to improve its understandability.	13.1
	18	Maximize the number of exercises with practical orientation.	11.7
	28	Increase the fun factor of learning (e.g., in lectures).	10.7
Certainty within the learning process	34	Reduce the risk of not being able to solve an exercise on my own.	12.5
	21	Reduce the insecurity of getting incorrect information.	10.8
	8	Maximize the number of opportunities to get direct feedback on exercises (e.g., based on e-learning).	10.6
Encouragement & support	26	Minimize the likelihood that I misestimate my personal time management throughout the semester.	12.4
	9	Maximize the number of achievements as success experiences within the learning processes.	12.2
	14	Reduce the effort to plan the semester.	11.5

Based on the characteristics of the selected opportunities, we derived four need-based clusters as central "jobs-to-be-done" within the learning process, which are presented in Table 1. The first opportunity cluster as job-to-be-done characterizes the availability of learning resources and information as important and unsatisfied outcome statements. This requirement involves increasing access to literature and information and reduced efforts to find relevant learning resources.

Furthermore, it is important that learning materials are consistent and steadily provided to reduce the possibility of missing materials. The students expect lecturers to provide more relevant and important information, scientific literature, and other published work inside their courses. However, our further analysis reveals that lecturers use literature sparsely in digital course rooms on the e-learning platform, although there is a separate module designed for such digital access for literature and other resources.

We identified the necessity for a university to further advance its core competencies from analog to digital mediation of academic knowledge by providing and delivering digital learning resources and content on a more open e-learning platform. Hence, educators at universities need to ensure that students have appropriate and more open access to literature, learning resources, and information while reducing the effort to find relevant resources by using an e-learning platform.

In the second opportunity cluster, students are looking for a higher degree of pragmatism of academic learning by higher flexibility, fun, graphicness/descriptiveness, and increased practical orientation. This cluster of pragmatism in learning should increase the motivation by building on more practice-orientated approaches, which prepare students for their future profession or enhance the ability to rework a course on their own (e.g., by providing class videos). There is a strong need to access the learning platform on mobile devices. In this case, the interfaces and the e-learning platforms should be optimized for such devices so that the effort to access learning materials is minimized and enable flexible learning "on-the-go" or remote (e.g., from home), which is independent of a desktop computer. Our analysis shows that most of the uploaded learning resources and materials are not compatible (i.e., fit on a variety of smaller screens, good readability, visibility) with such a mobile learning scenario, which causes problems and low satisfaction when learning on mobile devices.

The third cluster of opportunity outcome statements emphasizes students' need for certainty within the learning processes. Lecturers need to ensure the provision of relevant information to students and minimize the distribution of misleading or incorrect information. Additionally, students need to receive direct feedback about exercises on the e-learning platform and reduce the risk of not solving these exercises independently. We discovered different patterns of behavior among different faculties on the e-learning platform from the interviews.

For example, students from the largest Faculty 4 of Mechanical Engineering frequently use the e-learning platform and tools at the beginning of the semester and at the end right before the exams. In contrast to these student groups, students at the second-largest Faculty 1 of Mathematics, Computer Science, and Natural Sciences show a different behavior, which use and engage more regularly on the e-learning platform over the semester.

To investigate these two patterns, we segmented the ODI data according to faculty affiliation, and it turned out that outcome statement 8 to maximize direct feedback is not an opportunity for Faculty 1 (opportunity score below 10). The ODI segmentation results explain the different patterns of learning material used on an e-learning platform because students in Faculty 1 are strongly engaged with exercises such as lab experiments and programming sessions throughout the whole semester. Therefore, they already engage regularly with their professors and teaching staff that provide learning material on an existing e-learning platform while getting more direct feedback and information. Students from Faculty 1 are already getting up-to-date information and continuous feedback regarding course organization and requirements through continuous communication and engagement with digital learning materials on the e-learning platform (e.g., through assignments).

The continuous interaction on the e-learning platform reduces uncertainty because students get a clearer understanding of the expectation of completing the course. In contrast, students from Faculty 4 stressed in their interviews that often the course size is too large to engage in direct communication for feedback to professors or teaching staff. In these cases, frontal teaching approaches with only a final examination at the end of the semester are often applied to manage the large numbers of students by formalizing the teaching processes. From a student perspective, this approach provokes a high degree of information gathering at the beginning and end of the semester to plan the course efficiently and reduce uncertainty about the learning process.

The last cluster of outcome statements emphasizes the need for encouragement and support during the learning process that reduces uncertainty and organization efforts within the learning process. In particular, students need more support and encouragement when organizing the semester and engaging in formative assessment activities as part of their learning process. In this regard, students need more support and tools for managing their time and engagement during the semester. The university needs to provide more transparent and efficient digital tools for time management. Additionally, they need to inform students throughout the semester that they need to adapt their behavior and engagement in learning and assignments to

complete a course successfully. However, using the e-learning platform primarily as an upload tool of documents does not provide a detailed overview of progress nor provides feedback about successes or failures throughout the semester. Currently, professors or teaching staff cannot provide individual learning advice and encouragement by analyzing students' learning progress on demand, especially not for large courses. According to our results, key action points for developing user-centric e-learning solutions are interactive encouragement and support within the learning process. Interactive encouragement should be based on student incentivization, motivation, and self-management through learning analytics and tools usable for students and lecturers on the e-learning platform.

5. Discussion and implications

The results of the ODI have uncovered need-based innovation opportunities that are a fundament for a holistic digitization strategy that supports and enhances student learning in higher education. In line with past e-learning research [6, 26, 27], we confirm from our findings that an open e-learning platform has the job-to-be-done of simplifying organization and communication while enhancing access to different kinds of learning resources. An open e-learning platform should provide persistent storage and authoring tools to support independent and personalized learning [28]. However, such a platform also needs to allow collaboration among students while enhancing the quality, range, and diversity of learning resources provided by professors or teaching staff. In addition, students need guidance and feedback to become better learners. They need information about relevant learning materials and resources and their effect on their learning process to reduce uncertainty. Students also need to be aware of their learning status compared to their peers to reflect and assess their current learning progress and better plan and achieve their learning goals [27].

Thus, educators should create an appropriate pedagogical approach and learning design for e-learning implementation that utilizes practical and diversified learning resources. This approach includes the integration and execution of regular formative assessment activities within a digitalized pedagogical approach. Our findings imply that providing appropriate feedback and student engagement in the learning process is highly relevant and desirable for an e-learning solution [26]. The results also show that students are highly focused on pragmatism in achieving their academic degrees. This finding suggests that the underlying job of academic teaching is to efficiently qualify students for their future profession [6].

According to the student needs and jobs-to-be-done, the concept of blended learning provides a practical approach to manage the strategic transformation from analog to digital education [29]. In blended learning scenarios, the interaction between teachers and students still holds the central role, which encourages continuous learning and motivation. Thus, the blended learning concept can be regarded as a mediating concept between humans and novel e-learning technology on an open platform [30]. The combination of traditional and digital teaching concepts can serve different segments of students simultaneously. Our findings show that a pure "one-size fits all" e-learning strategy would not fit the identified student needs [28]. Combining analog and digital teaching concepts provides higher flexibility and serves different segments on an open e-learning platform with different technologies and methods [29].

However, it is important to identify which educational tools and technologies are effective to address students' needs and problems based on a blended learning strategy. Universities have to evaluate which concepts, tools, or technologies outperform the other to create a balance between novel e-learning services and traditional teaching methods. The ODI creates knowledge about students' needs and jobs-to-be-done that support the evaluation to improve student learning for better academic performance.

Researchers can link the ODI results to statistical analysis of e-learning usage data through learning analytics with the aim to develop need-based strategies and solutions (see Figure 2). A university can leverage usage data from their established e-learning technologies and platform architecture through Exploratory Log Data Analytics (ELDA) to identify and categorize learning patterns [6, 31]. Based on learning data analytics, universities can better understand which technologies, features, and concepts are more used and more effective within certain pedagogical settings or student segments [32]. Combining need-based information with learning analytics from established e-learning solutions improves the sensemaking to better adapt resources and technologies that address student needs most effectively. In line with the sensemaking theory of Gioia and Chittipeddi [8], the generated insights and knowledge create actionable need-based data intelligence (see Figure 2) and serve as a basis for the development of a need and user-centric strategy for digitizing higher education [6, 8].

The results of the ODI approach show that the output can be used to evaluate decision alternatives strategically and allocate resources effectively to address student needs in digitizing their learning process. The ODI approach is a valuable instrument for need-based sensemaking of the innovation portfolio, scarce resources, and for communicating the urgency of organizational change – explained as follows [8, 9, 16, 32]:

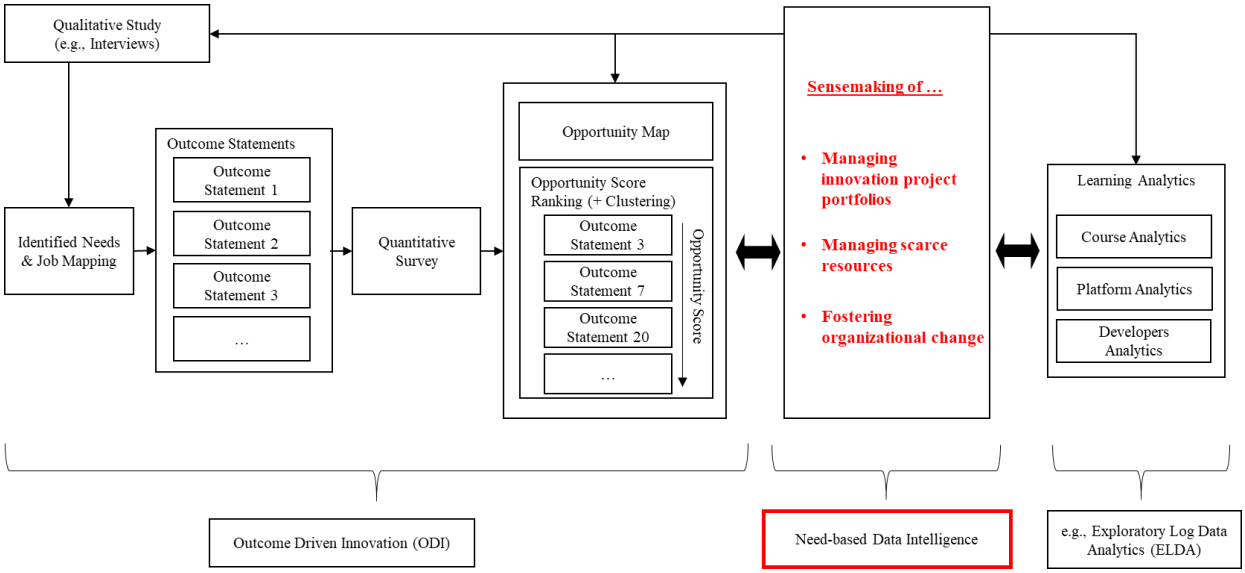

Figure 2. Need-based Data Intelligence Framework

Managing innovation project portfolios. When defining an innovation strategy, validated strategic decisions regarding the portfolio composition of innovation projects and their management are crucial for its future success [23]. The ODI screens the market and helps understand how existing solutions get the job done [21]. Categorizing needs in over-, under-, and appropriately served needs helps evaluate the current and future product, service, and solution portfolio as it reveals strengths and weaknesses. The generated intelligence is suitable for defining future innovation projects and adapting the portfolio of existing development projects. Hence, decision-makers can build a validated innovation project portfolio for blended learning strategies to reduce risk and leverage new e-learning solutions [16].

Management of scarce resources. Many organizations struggle with allocating financial resources within the innovation process to create novel value [12, 13]. It is crucial to understand the users' needs, problems, and usage patterns at an early stage of the innovation process [12]. The corresponding information can then be used as input for ideation activities. In addition, this information can be used to complement the strategic assessment of innovation investments by customer-oriented evaluation criteria and reduce resource dependencies [11]. Ulwick [16] has highlighted prioritizing development and innovation projects by the organization's benefit and value created for the customer/user. Projects and initiatives in the innovation portfolio have to be prioritized according to the fulfillment of underserved needs, which have not been served with the existing products & solutions. Therefore, adding user-based assessment criteria to screen and evaluate different idea concepts improves the overall innovative performance and increases the transparency of innovation processes and portfolios [12]. Decision-makers at universities can use the generated ODI information to prioritize existing and future innovation projects (e.g., innovation roadmaps). Based on need-based data intelligence, a university can now invest in developing blended learning solutions, which address the needs within the learning process and generate a real benefit for its users [21].

Foster organizational change. Despite providing strategic assessment criteria for portfolio management and resource allocation, the ODI can be used to accelerate organizational change [16]. Combining the opportunity score and map is the groundwork to develop need-based learning analytics (see Figure 2) that uses graphical interfaces for learning courses and platforms. Graphics and statistics as a descriptive communication tool for sensegiving [8] can effectively communicate user insights and strategic implications to a broad audience. Simplicity and graphicness facilitate communication and highlight the need for organizational change [23]. The communication of need-based information can reduce organizational inertia by receiving full commitment and acceptance from central stakeholders like students and lecturers for a digital learning strategy [3, 8]. For higher education providers, the results are valuable to identify current weaknesses in organizational structures that lead to underperforming solutions or products and services. The results also show that blended learning is best suited for the transition from analog to digital education, as it is likely to receive full commitment and acceptance from central stakeholders like students and lecturers [30].

Overall, the need-based data intelligence from the ODI can be used for the sensemaking and sensegiving process to set priorities in future development activities for designing specific actions, evaluating current formats, formulating and communicating a digitization strategy for higher education [7, 8]. Hence, ODI decision-makers can better present, negotiate, and argue for a range of strategies on the value of nascent technologies in e-learning [9].

7. Limitations and further research

From our study, we identified some limitations within the ODI approach that are avenues for future research. First, this methodology has only been applied in higher education on a highly aggregated level. Information about student needs within the learning process can reach from a highly aggregated level to a deep and granular degree of insights. Therefore, we recommend further investigating the performance of the introduced methodology by a demonstration and evaluation of the framework in Figure 2 at other universities and business schools. Second, a focus on other relevant stakeholder needs like professors or e-learning platforms like EDX, Udemy, etc., is lacking in this study, which may contribute to more insights. Third, students differ in terms of experience and attitudes along their learning process, which is not considered in this study. Therefore, future research should segment the population in a more granular fashion to break down the heterogeneity of the overall population into homogeneous segments of students. Using an outcome-based segmentation based on factor and cluster analysis within the ODI and data analytics can identify groups of students or lecturers with higher or more underserved needs or different usage patterns of e-learning technologies [16].

8. References

[1] Christensen, C.M. and M.R. Weise, "MOOCs' disruption is only beginning", The Boston Globe, 2014.

[2] Whitaker, J., J.R. New, and R.D. Ireland, "MOOCs and the Online Delivery of Business Education What's new? What's not? What now?", Academy of Management Learning & Education, 15(2), 2016, pp. 345–365.

[3] Eyring, H. and C. Christensen, "Changing the DNA of Higher Education", in The Innovative University: Changing the DNA of Higher Education from the inside Out. 2011.

[4] Weise, M.R. and C.M. Christensen, "Hire Education: Mastery, Modularization, and the Workforce Revolution", 0025-7206, 86(19), 2014.

[5] Wagner, N., K. Hassanein, and M. Head, "Who is responsible for e-learning success in higher education? A stakeholders' analysis", Educational Technology and Society, 11(3), 2008, pp. 26–36.

[6] Ferguson, R., "Learning analytics: drivers, developments and challenges", International Journal of Technology Enhanced Learning, 4(5/6), 2012, p. 304.

[7] Berente, N., S. Hansen, J.C. Pike, and P.J. Bateman, "Arguing the value of virtual worlds: Patterns of discursive sensemaking of an innovative technology", Management Information Systems Quarterly, 2011, pp. 685–709.

[8] Gioia, D.A. and K. Chittipeddi, "Sensemaking and sensegiving in strategic change initiation", Strategic Management Journal, 12(6), 1991, pp. 433–448.

[9] Nambisan, S., K. Lyytinen, A. Majchrzak, and M. Song, "Digital Innovation Management: Reinventing Innovation Management Research in a Digital World", MIS Quarterly, 41(1), 2017, pp. 223–238.

[10] Abrell, T. and M. Durstewitz, "The role of customer and user knowledge in internal corporate venturing: the viewpoint of the corporate entrepreneur", International Journal of Technology Management, 71(3-4), 2016, pp. 171–185.

[11] Gruner, K.E. and C. Homburg, "Does customer interaction enhance new product success?", Journal of Business Research, 49(1), 2000, pp. 1–14.

[12] Cooper, R.G., "Perspective: The Stage-Gate \textregistered Idea-to-Launch Process—Update, What's New, and NexGen Systems", Journal of Product Innovation Management, 25(3), 2008, pp. 213–232.

[13] Christensen, C.M., K. Dillon, T. Hall, and D.S. Duncan, Competing against luck: The story of innovation and customer choice, Harper Business, 2016.

[14] Creswell, J.W., "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", 13514180, 2013.

[15] Christensen, C.M., T. Hall, K. Dillon, and D.S. Duncan, "Know your customers"' jobs to be done"", Harvard Business Review, 94(9), 2016, p. 14.

[16] Ulwick, A.W., What customers want: Using outcome-driven innovation to create breakthrough products and services, McGraw-Hill/Irwin, New York, 2005.

[17] Griffith, T.L., "Technology features as triggers for sensemaking", Academy of Management Review, 24(3), 1999, pp. 472–488.

[18] Griffin, A. and J.R. Hauser, "The Voice of the Customer", Marketing Science, 12(1), 1993, pp. 1–27.

[19] Goffin, K., C.J. Varnes, C. van der Hoven, and U. Koners, "Beyond the Voice of the Customer: Ethnographic Market Research", Research-Technology Management, 55(4), 2012, pp. 45–54.

[20] Bettencourt, L.A. and A.W. Ulwick, "The customer-centered innovation map", Harvard Business Review, 86(5), 2008.

[21] Ulwick, A.W. and L.A. Bettencourt, "Giving Customers a Fair Hearing", MIT Sloan Management Review, 49(3), 2008, pp. 62–68.

[22] Ulwick, A.W., Jobs to be done: theory to practice, Idea Bite Press, 2016.

[23] Ulwick, A.W., "A New Perspective on Strategy", 2011.

[24] Yin, R.K., Case study research and applications: Design and methods, Sage publications, 2017.

[25] Buber, R. and H.H. Holzmüller, "Qualitative Marktforschung - Konzepte - Methoden - Analysen", 0042-3106, 2009.

[26] Piccoli, G., R. Ahmad, and B. Ives, "Web-Based Virtual Learning Environments: A Research Framework and a Preliminary Assessment of Effectiveness in Basic IT Skills Training", Management Information Systems Quarterly, 25(4), 2001, p. 401.

[27] Santhanam, R., S. Sasidharan, and J. Webster, "Using Self-regulatory learning to enhance E-Learning-Based information technology training", Information Systems Research, 19(1), 2008, pp. 26–47.

[28] Brown, J.S. and R.P. Adler, "Minds on Fire: Open Education, the Long Tail, and Learning 2.0", Educause review, 43(1), 2008, pp. 1–19.

[29] Garrison, D.R. and H. Kanuka, "Blended learning: Uncovering its transformative potential in higher education", Internet and Higher Education, 7(2), 2004, pp. 95–105.

[30] Bonk, C.J., C.R. Graham, J. Cross, and M.G. Moore, "The Handbook of Blended Learning: Global Perspectives, Local Designs", Higher Education, 2012, p. 624.

[31] Behrens, J.T., "Principles and procedures of exploratory data analysis", Psychological Methods, 2(2), 1997, pp. 131–160.

[32] Myatt, G.J., Making Sense of Data A Practical Guide to Exploratory Data Analysis and Data Mining, John Wiley & Sons, Inc, Hoboken, NJ, USA, 2007.

9. Appendix

ID	Statement	IMP	SAT	OS
1	Minimize the likelihood that course content provided by third parties is unreliable.	55.8%	29.6%	8.2
2	Maximize the number of opportunities to work interactively and online in order to reduce the necessity of physical meetings.	26.3%	32.7%	2.6
3	Maximize the likelihood that literature is free, flexible, and online available.	80.4%	22.5%	13.8
4	Increase the number of opportunities to state questions anonymously during lectures.	37.3%	33.0%	4.2
5	Increase the flexibility to study on-the-go.	59.5%	34.2%	8.5
6	Reduce the effort of communication in order to exchange with other students.	42.2%	42.5%	4.2
7	Increase the flexibility to rework lectures individually (e.g., from home).	81.8%	30.1%	13.3
8	Maximize the number of opportunities to get direct feedback on exercises (e.g., based on e-learning).	63.4%	21.0%	10.6
9	Maximize the number of achievements as success experiences within learning processes.	73.7%	25.6%	12.2
10	Increase the graphicness and clearness of course content to improve its understandability.	77.4%	24.3%	13.1
11	Reduce the likelihood to cheat oneself at learning.	47.2%	40.8%	5.4
12	Increase the number of e-learning exercises that include self-explanation methods in order to prove the personal level of comprehension.	54.4%	21.4%	8.7
13	Reduce the effort to obtain additional information from a lecture (e.g., additional examples, further explanations, application tasks, etc.).	69.6%	22.6%	11.7
14	Reduce the effort to plan the semester.	71.6%	28.3%	11.5
15	Reduce the amount of content that has to be memorized.	62.0%	26.0%	9.8
16	Reduce the likelihood that course content is not relevant for the future career path.	57.3%	26.1%	8.9
17	Minimize the likelihood that students do not engage in double-loop learning processes.	55.0%	28.3%	8.2
18	Maximize the number of exercises with practical orientation.	70.3%	23.8%	11.7
19	Increase the possibility to adapt learning processes to individual learning behaviors.	43.3%	26.9%	6
20	Minimize the amount of missing learning material.	86.8%	42.0%	13.2
21	Reduce the insecurity of getting incorrect information.	78.2%	48.1%	10.8
22	Minimize the effort to exchange learning material (e.g., in study groups).	55.9%	44.1%	6.8
23	Increase the likelihood to discuss effectively course content in forums.	38.7%	26.9%	5.1
24	Reduce the restrictions of e-learning platforms in order to get access to every course content.	48.0%	34.5%	6.2
25	Reduce the effort to check my personal learning progress.	56.5%	24.6%	8.8
26	Minimize the likelihood that I misestimate my personal time management throughout the semester.	76.4%	28.8%	12.4
27	Reduce the effort to find certain information and content using (e.g., on e-learning platforms, etc.).	72.3%	36.4%	10.8
28	Increase the fun factor of learning (e.g., in lectures).	63.1%	18.8%	10.7
29	Reduce the effort of communication between students or between students and lecturers.	43.1%	40.2%	4.6
30	Reduce the time effort to find the right contact person.	61.0%	38.5%	8.4
31	Reduce the risk of missing important statements/questions from other students.	51.0%	27.5%	7.4
32	Increase the availability of e-learning devices in an offline environment.	61.6%	29.9%	9.3
33	Reduce the likelihood that introduced approaches to solve an exercise are not the most efficient ones.	56.1%	33.4%	7.9
34	Reduce the risk of not being able to solve an exercise on my own.	75.4%	25.6%	12.5
35	Increase the possibility to adapt learning processes to the individual learning progress.	49.5%	21.9%	7.7
36	Increase the possibility to participate actively in lectures.	38.2%	31.9%	4.5

Appendix 1. Outcome statements (translated from German to English) with ID number, importance (IMP), satisfaction (SAT), and opportunity score (OS)